

<i>Type</i>	Progress Report
<i>Grant</i>	PHYSICAL PROPERTIES OF COMETARY NUCLEUS CANDIDATES
<i>Number</i>	NAG 5-10437
<i>Period</i>	Year 2 of 3: 3/01/02-2/28/03 (\$58,000)
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Goals

In this proposal we aim to study the physical properties of the Centaurs and the dead comets, these being the precursors to, and the remnants from, the active cometary nuclei. The nuclei themselves are very difficult to study, because of the contaminating effects of near-nucleus coma. Systematic investigation of the nuclei both before they enter the zone of strong sublimation and after they have depleted their near-surface volatiles should neatly bracket the properties of these objects, revealing evolutionary effects.

Accomplishments in Year 2

In the second year of this grant we have done the following:

- 1 Secured data on the Mauna Kea 2.2-m, CFHT, Keck and Subaru telescopes in pursuit of the proposed physical studies. We have secured measurements primarily in the optical BVRI bands but also, to a more limited extent, in the near and thermal infrared.
- 2 We have established that there is a distinct and statistically significant difference between the surface reflection properties (broadly, "color") of the cometary nuclei and their parents in the Kuiper Belt. This result is the first to show that the ultrared (and maybe ultraprimitive) matter that distinguishes the surfaces of many Kuiper Belt Objects (KBOs) is rare or missing on the surfaces of the cometary nuclei and their inactive remnants. This evolutionary effect has implications for future NASA studies of comets: we will not sample on the comets the same primitive matter that

we can detect colorimetrically in the Kuiper Belt. This work was published in The Astronomical Journal (Jewitt 2002) and presented as part of an invited talk at ACM Berlin (Jewitt 2002b).

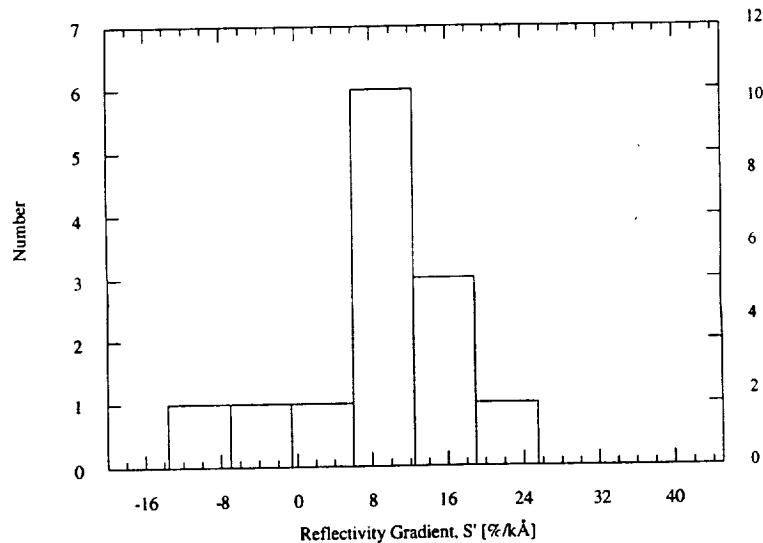


Figure 1: Histogram of the color distributions of cometary nuclei (empty histogram) and KBOs (shaded histogram). The distributions are significantly different. In particular, ultra-red matter ($S' \geq 25 \text{ \%}/1000\text{\AA}$) is common on the KBOs but missing on the nuclei. From Jewitt (2002a).

3. We have photometrically isolated the nucleus of 143P/Kowal-Mrkos and measured its rotational properties. This work, together with a detailed analysis of the shape distribution of cometary nuclei and related bodies, has been submitted for publication in Astronomical Journal.

4. We have conducted a program of observations of asteroid-comet transition object 133P/Elst-Pizarro. The dust trail identified in 1996 and then thought to be a transient feature produced by chance collision with a small asteroid (Elst-Pizarro is itself a dynamically unremarkable asteroid) has been re-observed in 2002/2003. We find that it is a true cometary feature, meaning that some main-belt asteroids are ice-rich in their surface regions.

Plans for Year 3

- 1 We will complete the analysis of 133P and submit this work for publication.
- 2 We will complete the collection of data for a dust search in the NEO population. This work will update our earlier paper on profile-fitting, to attempt to narrow the gap between the most weakly active comets and the apparently inert NEOs.
- 3 Time acquired on the Keck telescope will be used for thermal-optical measurements of the Jovian trojan asteroids, objects that share physical similarities with the cometary nuclei. It has long been thought that the Trojans could be ice-rich beneath their (possibly quite thin) refractory surface mantles.

Publications of Year 2

- D. Jewitt (2002a). From Kuiper Belt Object to Cometary Nucleus: The Missing Ultra-Red Matter. *Astronomical Journal*, 123, 1039-1049.
- D. Jewitt (2002b). From Kuiper Belt to Comet Nucleus. In *Proceedings of Asteroids, Comets, Meteors 2002*, ESA Special Publications Series, in press.
- D. Jewitt, S. Sheppard and Y. Fernandez (2003). 143P/Kowal-Mrkos and the Shapes of Cometary Nuclei. *Astron. J.*, submitted.



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION RESEARCH GRANT SUPPLEMENT

RESEARCH GRANT SUPPLEMENT
02 JUL 15 18:37

1. To: UNIV HAWAII
OFFICE OF RESEARCH SERVICES
2530 DOLE ST/SAKAMAKI D-200
HONOLULU, HI 96822-3203
2. Grant Number: NAG5-10437
3. Supplement: 0001
4. Effective Date: 03/01/2001
5. Expiration Date: 02/28/2004

6. For research entitled:
PHYSICAL PROPERTIES OF COMETRAY NUCLEUS CANDIDATES

7. Under the direction of (Principal Investigator): DAVID JEWITT

8. Award History

Previous amount: \$55,500.00
This action: \$58,000.00
Total to date: \$113,500.00

Funding History

Previous obligation: \$55,500.00
This action: \$58,000.00
Total obligation to date: \$113,500.00

9. Accounting Data: OBJECT CLASS: 4111 PPC: RT B/NC: 805

PCN	JON	APPROP	BLI	PC	AMOUNT
201-21515	077-344-32-00-06	801/20110(01)	A7-01	1C	55,500.00
201-80155	077-344-32-00-06	801/20110(01)	A7-01	1C	58,000.00

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Letter of Credit: 030

11. This grant is awarded under the authority of 42 U.S.C. 2473 (c) (5), et seq., and is subject to all applicable laws and regulations of the United States in effect on the date this grant is awarded, including but not limited to 14 CFR Part 1260 (Grants and Cooperative Agreements).

12. Applicable statement if checked:

- ☒ The Federal Demonstration Partnership General Terms and Conditions and NASA Agency-Specific Requirements to this award.
- ☒ No change is made to existing provisions or special conditions.
- ☐ Secondary Administration Delegation

UNITED STATES OF AMERICA

Applicable enclosure(s), if checked:

- ☐ Provisions
☐ Special conditions
☐ Required Publications and Reports

TRACEY A. JONES

(Date)

Contracting Officer

For access to the NASA Grants and Cooperative Agreement Handbook and status of any future GSFC Grant awards, visit <http://genesis.gsfc.nasa.gov/grants/grants.htm>



GODDARD SPACE FLIGHT CENTER

ADDITIONAL TERMS

NAG5-10437

THE PERIOD OF PERFORMANCE IS EXTENDED FOR 24 MONTHS.

**THIS SUPPLEMENT PROVIDES FUNDING FOR YEAR 2 OF A MULTI-YEAR PROPOSAL,
THEREFORE A NEW TECHNICAL PROPOSAL IS NOT REQUIRED.**